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SECURITY INFORMATION

SECRET

CENTRAL INTELLIGENCE AGENCY

REPORT

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COUNTRY USSR

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SUBJECT Guided Missile Development

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Appendix 'B'

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USAF review completed.

Guided Missiles - See separate sheets attached.

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25 YEAR RE-REVIEW

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GUIDED MISSILES

(a) [redacted] expansion ratio (exit area to throat area) of the engine [redacted] 25X1

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Model	Exp. Ratio	Comb. Press.	Theoretical Exhaust Velocity
25 ton	3.4	15 atm.	2000 m/sec.
35 ton	"	20 atm.	2000 m/sec.
100 ton	16.0	60 atm.	2360 m/sec.

The higher expansion ratio for the 100 ton model follows from the greater combustion pressure employed.

(b) [redacted] 25X1

Model	Max. Diam. Comb. Chamber	Throat Diameter	Exit Diameter
25 ton	950 mm.	400 mm.	740 mm.
35 "	950 "	400 "	740 mm.
100 "	1200 "	470 "	1800 "

The above are inside dimensions. The outside diameter would exceed the above by twice the depth of the cooling jacket, i.e. by about 30-50 mm.

(c) [redacted] 25X1

The standard A-4 has a specific thrust of 210 Kg. If this figure is maintained for the larger (100 ton) model, the designed fuel consumption of 500 Kg/sec. would yield 105 tons thrust. With the paraffin fuel, a higher specific thrust is expected. 25X1

(d) [redacted] 25X1

The theoretical value for paraffin is 240 kg., giving a maximum theoretical thrust of 120 tons for a fuel consumption of 500 Kg/sec.

(e) [redacted]

(f) [redacted] 25X1

The paraffin has the characteristics of ordinary Kerosene (lamp oil). The specific impulse is 240 Kg.

(g) The single stage centrifugal pumps work against a head of about 2300 ft. Pumps of known design can provide about 600-800 ft. head at high flow.

[redacted]

It is admitted that the fuel pump (alcohol) on the standard A-4 has a delivery pressure of 25 atmospheres (800 ft.) at 3800 rpm. The same pump on the 35 ton model running at 5000 rpm., reaches a pressure of 35 atmospheres (1100 ft.). These are test figures for single stage, single entry centrifugal pumps. With double entry pumps higher delivery are anticipated and [redacted] with minor alterations in blade design the 70 atmosphere delivery pressure should be realizable. 25X1

[redacted]

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(h) [redacted] 25X1

The nozzle shape was based on theoretical considerations. [redacted]

(i) Calculations show that a Hydrocarbon such as "paraffin" may be used successfully to regeneratively cool an engine of this size. [redacted] 25X1

The possibility of ultimately using the cooling jacket as a steam generator to assist the peroxide plant was considered.

(j) [redacted] 25X1

25X1

The original intention was to vapourize the water, and subsequently condense it by means of liquid oxygen.

(k) [redacted] 25X1

In the final design, the water was not thrown away.

(l) [redacted] 25X1

Note: [redacted] several cooling alternatives were investigated [redacted] it is quite possible that in the final version alcohol will replace the paraffin, and [redacted] the normal A-4 cooling process will be adopted. 25X1

(m) The water pump is reportedly "carried" by the paraffin pump. [redacted]

The pumps are mounted on either side of the steam turbine, with the Oxygen and Peroxide pumps on the left and the paraffin and water pumps on the right. The casings of the individual pumps are located on each other, by means of special pads and the drive is by a common sub-divided shaft. 25X1

(n) For the flow rate of Hydrogen Peroxide, the calculated turbine efficiency is 55%. [redacted]

The 75% efficiency was hoped for in the final design.

(o) [redacted] 25X1

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The weight of the 100 tons combustion chamber together with the exhause nozzle is 800 Kg. The turbo-pump unit consists of the 2-stage steam turbine (500 mm rotor diameter) together with:-

Oxygen pump	.....	320 mm rotor
Paraffin "	.....	360 mm rotor
Water "	.....	210 mm rotor
Peroxide "	.....	280 mm rotor

The estimated design weight of the complete 2-stage steam turbine assembly is 350 Kg. Other component weights not known.

Note: The turbo-pump assembly of the standard V.2 weights 180 Kg.

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(p)

The liner consisted of pure copper (commercial grade). In version (1) the thickness is 1 mm at the bridge pieces with 4 mm at the soldered joints. The outer steel shell is 5 mm thick, and is required for strength.

25X1

(q)

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(r) In the second chamber design, a second flat copper sheet was welded to the inner side of the corrugated copper plate.

a thrust frame was designed which could house the pump assembly

- end -

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